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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/698,659

Filing Date: October 31, 2003

Appellant(s): LEISTRA ET AL.

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George A. Coury  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed January 29, 2009 appealing from the Office action  
mailed July 29, 2008.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows: the Ground 4 should read Wessel/Asukabe in view of Wesel/Menjak **in view of Wesel** / all in view of Cadaval and Nakawa.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

20030008196	WESSEL ET AL	1-2003
6,685,806	CADAVAL FERNANDEZ	2-2004

DE LECETA ET AL

6,335,112	ASUKABE ET AL	1-2002
20030059664	MENJAK ET AL	3-2003
JP07024315A	NAKAWA ET AL	1-1995
5,981,097	RAJENDRAN	11-1999

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-3, 5-9, 11-12, 14, 24-27, 29, and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wessel et al (US 20030008196) in view of Cadaval Fernandez De Leceta et al (US 6685806).

Wessel et al discloses a method for making improved membrane electrode assembly in a standard fuel cell (See P2). The standard fuel cell 1 in accordance with the current state of the art (See FIG. 1) consists of two gas-permeable, porous electrodes 2 located opposite one another, which comprise a porous, electrically conductive substrate 3 and an electrocatalytic layer 4. A *gas-tight* membrane 6 containing electrolyte is located in the gap 5 provided between the electrodes 2. (See P26). Wessel et al teaches that the standard fuel cell may be improved by using at least one *additive* which prevents the formation of peroxides and/or decomposes peroxides (claimed peroxide decomposition catalyst) as a constituent of the electrocatalytic layer 4 (See P27). This is carried out, in particular, by *coating on* the electrodes 2 with electrocatalytically active materials (standard catalysts) (See P30), for example with noble

metals, such as platinum, palladium, silver, ruthenium or iridium, or combinations thereof and with deperoxidation-active compounds and/or elements (See P27), in particular by *impregnation* techniques (See P28). The electrocatalytic layer 4 accordingly comprises at least one standard catalyst and at least one additive as a constituent of the electrocatalytic layer 4, the at least one additive is preferably present, based on the at least one standard catalyst, in a ratio by weight of from 1:10 to 1:0.5, particularly preferably in a weight ratio of from 1:5 to 1:1 (See P29). The peroxide decomposition catalyst has selectivity when exposed to hydrogen peroxide toward reactions which form benign products from said hydrogen peroxide (See Paragraphs 13-15).

Thus, Wessel teaches all features of independent claims 1 and 25, namely, membrane electrode assembly: *(porous)* cathode/*(porous)* decomposition catalyst layer/**(non-porous)** **membrane** *(porous)* anode, except for decomposition catalyst layer having porosity of less than or equal to 20 % (Claims 1 and 25).

However, Cadaval Fernandez De Leceta et al teaches that membrane electrode assembly (MEA) consisting of a membrane and porous layers of electrode material with the porosity that decreases in the direction of the membrane with a porosity gradient of 5-15% per 1  $\mu$  improves the electrochemical characteristics of MEA (See column 6, lines 50-55). The porous layers of the electrode material have a general porosity comprised between 40 and 70% (See Abstract; column 6, lines 65-68). Note that it is not clear from the above wording (i) whether the general porosity of any value within the range of 40 and 70% decreases with a porosity gradient of 5-15% per 1  $\mu$  to any desired final porosity, e.g. to less than 40% or (ii) the general porosity decreases with a porosity gradient of 5-15% per 1  $\mu$  but the porosity stays within the range, i.e. does not decrease below 40%. However, the Example 5 shows that the electrode layer is applied to CEM

membrane having **diameter of 50 mm** and thickness of **150  $\mu$**  (See column 14, line 21) in such a thickness, that an electrocatalyst loading of **0.3 mg/cm<sup>2</sup>** (See column 14, lines 47-48) would be obtained with the general porosity of **45 %** that decreases with a porosity gradient of 10% per 1 $\mu$  (See column 14, lines 59-60), i.e. **45% would decrease to 40.5% in 1  $\mu$  of electrode.**

According to interpretation (ii) the electrode should have **thickness** of a little bit greater than **1 $\mu$**  to achieve 40% porosity from the general porosity of 45 %. Moreover, simple calculations show that it is hardly possible to achieve target electrocatalyst loading of **0.3 mg/cm<sup>2</sup>** on the membrane having diameter of **50 mm** by depositing 1 $\mu$  thickness electrode. Therefore, it is more logical to interpret according to (i), the general porosity of *any* value within the range of 40 and 70% decreases with a porosity gradient of 5-15% per 1  $\mu$  to any desired final porosity, e.g. to less than 40%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed electrode of Wessel et al having coating of peroxide decomposition catalyst with porosity that decreases in the direction of the membrane with a porosity gradient of 5-15% per 1 micron with the expectation of providing the desired improved electrochemical characteristics of MEA, as taught by Cadaval Fernandez De Leceta et al.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant porosity gradient/porosity parameters (including those of claimed invention) in the cited prior art through routine

experimentation depending on particular use of a final product in the absence of showing of criticality.

As to claims 2-3, Wessel teaches that each electrocatalytic layer 4 (claimed layer between the anode and said membrane) (See Fig. 1; P10-12, 26-32) comprises at least one standard catalyst such as Pt, Pd, Ag, Ru, Ir (See P27) with a *peroxide decomposition additive* (claimed peroxide decomposition catalyst) comprising at least one element or at least one compound from the groups consisting of metallic transition elements of the Periodic Table of the Elements, i.e. from groups IIIb, IVb, Vb, VIb, VIIb, VIIIb, Ib and IIb, or at one least metallic element or at least one compound from main group 4 (IVa) of the Periodic Table of the Elements, in particular, at least one of the elements Co, Fe, Cr, Mn, Cu, V, Ru, Pd, Ni, Mo, Sn or W (See P31) preferably in heterogeneous form in combination with at least one support substance such C, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, zeolites and heteropoly-acids (See P32).

As to claims 5-7, it is the Examiner's position that the electrocatalytic layer deposited on the cathode would act as oxygen reduction catalyst. It is the Examiner's position that the electrocatalytic layer deposited on the anode would act as oxygen reduction catalyst at anode potential because it is well known in the art that an anode *typically* includes hydrogen oxidation catalyst (See Applicants' specification, P30).

Claims 1-3, 5-9, 11-12, 14, 24-27, 29, and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asukabe et al (US 6,335,112) in view of Wessel et al, further in view of Cadaval Fernandez De Leceta et al.

Asukabe et al disclose a method for making membrane electrode assembly, comprising the steps of: providing a membrane electrode assembly comprising a fuel electrode for hydrogen oxidation (anode) (See column 3, lines 7-14); an oxidizer electrode for oxygen reduction (cathode) (See column 3, lines 15-29) and a membrane disposed between said anode and said cathode. A hydrogen peroxide decomposition catalyst is added to the membrane and/or to the oxidizer electrode (See column 4, lines 1-5) or to the fuel electrode (See column 4, lines 5-6). The hydrogen peroxide decomposition catalyst comprises oxide catalysts of elements such as Ru, Mn, Zr, Al, Si, Ti (See column 4, lines 15-37), transition metal alloy catalysts of elements such as Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, Ru, Rh, Pd, Ta, W, Re, Ir and Pt (See column 4, lines 48-59).

Asukabe et al fails to teach that a hydrogen peroxide decomposition catalyst is deposited as a layer *onto* a membrane or anode or cathode (Claim 1) by impregnating (Claim 33).

Wessel et al teach that a hydrogen peroxide decomposition catalyst may be deposited into or onto electrodes (See P12).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have deposited a hydrogen peroxide decomposition catalyst in Asukabe et al onto electrodes with the expectation of providing the desired hydrogen peroxide decomposition since Wessel et al teach that a hydrogen peroxide decomposition catalyst may be deposited into or onto electrodes.

The cited prior art fails to teach that the additive coating layer has porosity of less than or equal to 20 % (Claims 1 and 25).

Cadaval Fernandez De Leceta et al are applied here for the same reasons as above.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed electrode of the cited prior art having coating of peroxide decomposition catalyst with porosity that decreases in the direction of cation-exchange membrane with a porosity gradient of 5-15% per 1 micron with the expectation of providing the desired improved electrochemical characteristics of MEA, as taught by Cadaval Fernandez De Leceta et al.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant porosity gradient/porosity parameters (including those of claimed invention) in the cited prior art through routine experimentation depending on particular use of a final product in the absence of showing of criticality.

Claims 1-3, 5-9, 11-12, 14, 24-27, 29, and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menjak et al (US 20030059664) in view of Wessel et al, further in view of Cadaval Fernandez De Leceta et al.

Menjak et al disclose a method for making membrane electrode assembly, comprising the steps of: providing a membrane electrode assembly comprising a hydrogen oxidation electrode (anode) (See P13) with a hydrogen oxidation catalyst (See P32) such as graphite (See P84); an oxygen reduction electrode (cathode) (See P13) with an oxygen reduction catalyst such as a *layer* 35 of carbon (See P91), which may be impregnated with a catalyst material comprising element of Ag, Mn (See P97); and a membrane disposed between said anode and said cathode. The oxygen electrode comprising a peroxide decomposition catalyst layer composed of a carbon

matrix and a peroxide decomposer with an active catalyst material chemically impregnated within the carbon matrix between said anode and said membrane (See Fig. 9; P94, 95), the peroxide decomposer comprising Ag (See P 95, 97), wherein said peroxide decomposition catalyst has selectivity when exposed to hydrogen peroxide toward reactions which form benign products from said hydrogen peroxide (See Paragraphs 96-98).

Menjak et al fails to teach that a hydrogen peroxide decomposition catalyst is deposited as a layer *onto* a membrane or anode or cathode (Claim 1) by impregnating (Claim 33).

Wessel et al teaches that a hydrogen peroxide decomposition catalyst may be deposited *into or onto* electrodes (See P12).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have deposited a hydrogen peroxide decomposition catalyst in Menjak et al onto electrodes with the expectation of providing the desired hydrogen peroxide decomposition since Wessel et al teach that a hydrogen peroxide decomposition catalyst may be deposited *into or onto* electrodes.

The cited prior art fails to teach that the additive coating layer has porosity of less than or equal to 20 % (Claims 1 and 25).

Cadaval Fernandez De Leceta et al are applied here for the same reasons as above.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed electrode of the cited prior art having coating of peroxide decomposition catalyst with porosity that decreases in the direction of cation-exchange membrane (MEA) with a porosity gradient of 5-15% per 1 micron with the expectation of

providing the desired improved electrochemical characteristics of MEA, as taught by Cadaval Fernandez De Leceta et al.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant porosity gradient/porosity parameters (including those of claimed invention) in the cited prior art through routine experimentation depending on particular use of a final product in the absence of showing of criticality.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wessel et al in view of Cadaval Fernandez De Leceta et al or Asukabe et al in view of Wessel et al, further in view of Cadaval Fernandez De Leceta et al or Menjak et al in view of Wessel et al, further in view of Cadaval Fernandez De Leceta et al, as applied above, and further in view of Nakawa et al (JP 07024315).

The cited prior art fails to teach that carbon is used as a peroxide decomposition catalyst. However, Nakawa et al teach that activated carbon is suitable for the use as a peroxide decomposition catalyst (See Abstract).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used carbon as a peroxide decomposition additive in the cited prior art since Nakawa et al teach that activated carbon is suitable for the use as a peroxide decomposition catalyst.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Rajendran (US 5981097) teaches that the porosity of catalyst layers 22 and 30 (anode and cathode) is generally in a range of 10 to 99%, preferably 10 to 60% (See column 8, lines 36-40).

#### **(10) Response to Argument**

##### **Ground 1**

Appellants assert that the Examiner has focused on the teaching of Cadaval '806 without considering the teaching as a whole. The teaching cited by the Examiner in the abstract and column 6, lines 50-54, teach that such electrodes have a porosity between 40 and 70% decreasing in the direction of the membrane, and that this decrease is with a porosity gradient from 5-15%. In other words, the porosity varies between 70 and 40%. Nowhere does this teach anything less than 20% as called for by the present claims. Further, this is porosity within the electrode, and not in an adjacent layer. It is respectfully submitted that these are clear distinctions between the '806 patent and the subject matter of the present claims, particularly where the '806 patent is being cited for supposedly relevant teaching. None of the art of record discloses or suggests the less than 20% limitation of independent claim 1.

The Examiner respectfully disagrees with this argument for the same reasons as discussed above. In contrast to Applicants argument, considering the teaching of Cadaval '806 as a whole, it is clear that the general porosity of *any* value within the range of 40 and 70% decreases with a porosity gradient of 5-15% per 1  $\mu$  to any desired final porosity, e.g. to less than 40%.

##### **Ground 2**

Appellants assert that this rejection also relies upon Cadaval '806 for the teaching of less than 20% porosity, and is therefore deficient for the reasons set forth above in Ground 1.

The Examiner respectfully disagrees with this argument for the same reasons as discussed above.

##### **Ground 3**

Appellants assert that this rejection also relies upon Cadaval '806 for the teaching of less than 20% porosity, and is therefore deficient for the reasons set forth above in Ground 1.

The Examiner respectfully disagrees with this argument for the same reasons as discussed above.

Ground 4

Appellants assert that this rejection is of dependent claim 10 which is supported by the same argument supporting claim 1 in ground 1 above.

The Examiner respectfully disagrees with this argument for the same reasons as discussed above.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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